The Influence of Personality on the Making of Snap Decisions and Change of Mind

By

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Statement of Sources

I declare that this report is my own original work and that contributions of others have been duly acknowledged.

Signed

Date

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Abstract

The present study is interested in whether personality such as impulsivity, stubbornness and the need for closure affect the way in which an individual makes a snap decision and subsequently rates their confidence in their decision or changes their mind. Fifty-two participants from the University of Tasmania completed 3 personality inventories and a memory task. Participants were shown a study list of words to memorise. Half of these words appeared in the experimental phase as “old” words, and the other half were “new”. In a two-step decision process, participants were first to make a snap decision if the word was old or new. They were then to rate their confidence in their answer or change their mind if they made an error. Analysis showed that there were limited differences in the way that participants responded to the first decision. For the second response, the need for closure and dysfunctional impulsivity (a subset of impulsivity) were found to have the strongest correlation with the number of response reversals and the use of the high confidence option. However, a key limitation to the study was the small sample size, which prevents the null from being supported or rejected. Additionally, the inventory used to measure stubbornness was inadequate for differentiating between participants. In future replications of this study, a larger sample size should be used, and new measure of stubbornness should be developed.

Decision making and change of mind processes are often studied in tasks that manipulate reaction time and accuracy. The aim of past research has been to determine what the underlying mechanisms are in order to improve accuracy. Currently, results have been inconsistent in the description of how these processes eventuate. One possible explanation for this is individual differences in personality. Personality traits are pervasive and unchanging and have not been considered in current models that are used to explain the decision making and change of mind processes. The present research aims to use personality differences to explain why decision making and change of mind results can be inconsistent across participants.

Decision Making

Decision making can be defined as the process of reaching a conclusion after some consideration of the information that is presented (Simon, 1959). “Snap” or quick decision making can be considered as deciding without taking time to deliberate on the answer. An individual who does this easily can be considered impulsive. The foundation for making a snap decision is the speed accuracy trade off (SAT). The SAT refers to the phenomenon where a preference for fast responding often results in a low accuracy, and vice versa (Reed, 1973). The SAT can be demonstrated by asking participants to respond as quickly and as accurately as they can to a stimulus eliciting a fast reaction time, and low accuracy (Fitts, 1966; Lappin & Disch, 1972; Swensson, 1972). In contrast, the number of errors made in choice response tasks decrease when more time is allowed to make the recognition memory decision (Wood & Jennings, 1976).

Decision making can be modelled from the foundation of the SAT with the use of perceptual measures and 2-choice memory tasks (Stone, 1960). For example, Vickers (1970) introduced the accumulator model, which can be used to map reaction time (RT) and error rates. Smith and Vickers (1988) identified three components within the model that are

involved in decision making. The first is the sensory coding stage following exposure to the stimuli, the second involves evidence accumulation, and the third is the stopping point, which is known as the decision threshold. Many researchers have developed and tested their own versions of the accumulator model (e.g. Ratcliff, 1978; Townsend & Ashby, 1983; Vickers & Smith, 1985; Brown & Heathcote, 2005). Brown and Heathcote (2008) developed the linear ballistic accumulator model (LBA), which provides a simple explanation of evidence accumulation, and thus, decision making. The LBA states that for binary choice there are two separate accumulators, one for each response option. Both accumulators begin with a small amount of evidence, which is dependent on the participants biases. For example, in a recognition memory task, the word chocolate may already elicit a strong sense of recognition. This means that there is already a large amount of bias towards the "old" accumulator (i.e., recognise), when compared with the accumulator representing "new" (i.e., don't recognise). After the presentation of a word during a test phase, evidence begins to build in both accumulators at different rates, known as the drift rate. This continues until the evidence threshold is reached first in one accumulator, which then triggers the corresponding decision (Brown & Heathcote, 2008).

The LBA was developed in order to predict fast and slow errors in decision making, which is discussed by Donkin, Heathcote, and Brown (2009). A fast error occurs when an individual sets the decision threshold too low, and there is a large amount of bias towards the incorrect response. In contrast, slow errors occur when the threshold is high, and accuracy is emphasised. In the first scenario, the drift rate for the correct response is faster than for the incorrect response, but not enough time is available for the accumulator corresponding to the correct response to reach its threshold first. When accuracy is emphasised, the correct response overtakes the incorrect due to its greater drift rate and the longer time available (Brown & Heathcote, 2008).

The predictive capacity of the LBA has been measured in lexical decision tasks (Brown & Steyvers, 2005) and brightness discrimination tasks (Ratcliff & Rouder, 1998). The LBA was successful in predicting both fast and slow errors challenging tests, which other models have failed to achieve in the past (Brown & Heathcote, 2008). Heathcote and Love (2012) found further support for this model in a comparative study. Again, the LBA was also found to be a successful fit to the data from Wagenmaker, Ratcliff, Gomez and McKoon's (2008) study.

Change of Mind

Speeded decision making is a process that can be error prone, which is important to understand when investigating the process of change of mind. Rabbitt (1969) introduced the area of research that focuses on error detection. He proposed that following a decision there is a refractory period where no new information can be processed, as the brain is determining if the initial decision is correct. Rabbitt and Rogers (1977) investigated this concept in a 2-choice task, where participants were to respond with their left hand to a number 4, and their right hand to a number 5. Seventeen percent (146) of the 816 errors made followed another error. The second error was the correct response to the first error 74% (108) of the time. This was labelled as involuntary error correcting, which both implies that participants are aware when an error is made and are able to correct them.

From these findings, the researchers developed the parallel process committee decision model. In this model, there are a number of independent systems, known as committee members that process the signals from stimuli in parallel. Each committee member identifies and compares the different response options before casting a vote for a particular response. The votes that are made early in the process are prone to error. When a decision is made based on early votes, a change of mind occurs 85% of the time, as the final committee vote is different from the initial vote. Rabbitt and Vyas (1981) however, found

that this effect is only found when there is a time pressure present. If participants are given enough time to consider the correct response, the initial decision is based on the entire committee's vote. In this circumstance, only 24% of errors are corrected. This demonstrates that the errors are not being made as a result of the speeded response, but a genuine lack of memory.

Based on this research, Van Zandt and Maldonado-Molina (2004) developed the reverse response model, which is an extension of the accumulator model described by Van Zandt (2000). As described previously, there are two competing accumulators, one that is collecting evidence for the "old" previously learned information, and one that is collecting "new" evidence. Each counter has an evidence threshold set, and the two are competing. Errors are made when the incorrect response reached the evidence threshold first, due to the presence of bias, or false motor responses.

Van Zandt and Maldonado Molina (2004) expanded the model to reflect the balance of evidence hypothesis (BoE; Vickers, 1979). The BoE suggests that an individual's confidence is dependent on the difference in evidence that has been accumulated at the time a decision is made. If the difference in evidence between the two accumulators is small, the individual has low confidence in their response. However, if the difference is large, one is high in confidence in one's response (Vickers, 1979). In addition, the presence of bias will result in response reversals. Incorporating this, the reverse response model therefore describes a two-step decision process. The first step is to determine if a word is "old" or "new", which participants were given up to 700ms to do. The second uses a confidence rating along a 6-point likert scale, from "certain old" to "certain new". If participants respond "old" to the first response, but "certain new" to the second, this would be recorded as a change of mind response (Van Zandt & Maldonado-Molina, 2004). This is determined by the amount of evidence that is accumulated in the two counters. If there is a small amount of difference in

evidence between the two counters, the participant is less confident in their answer, and this is where a change of mind is most likely to occur. The researchers found that in contrast to the BoE, it was not the presence of bias that determined if there was a response reversal, but the inaccuracy of the first response. Despite this, it continues to emphasise that participants are aware when errors have been made (Van Zandt & Maldonado-Molina, 2004).

Similarly, Curran, Debuse and Leynes (2007) investigated the use of response reversals in a recognition memory task. Participants were to respond either “old” or “new” to a study list of words after a delay period. The researchers found that 48% of the incorrect responses were changed at the second response. In contrast to these findings, Hickey (2017) used a similar paradigm, but with inconsistent results. Participants were to make the initial response within 1 second and were given five seconds to make a confidence response. The researcher found that a large number of participants were consistently high in confidence and would not re-evaluate the first response. Koriat, Lichenstein and Firschoff (1980), indicate that participants are biased towards their decisions, and can therefore become overconfident when given the opportunity to re-evaluate them. Similarly, Moore and Healy (2008) highlight that individuals tend to be overconfident in their abilities, particularly when the task appears to be simple.

Overconfidence is not isolated to laboratory tasks, but it is also prevalent in real world settings. Zeng (1992) showed that 37% of workers at an engineering firm believed that they were in the top 5 performers in the workplace. Twenty five percent of students rate themselves in the top 1% of academic achievers, and 93% of American drivers indicate that their driving is above average (Svenson, 1981). In addition, this has been found in speed accuracy tasks, where participants provide a confidence rating following their first response. Soll and Klajman (2004) found that when participants used the 90% confidence ratings, the response was correct only 50% of the time. Findings such as this have led to the theory of

confidence, which suggests that the information individuals have regarding their abilities can be inaccurate, which can lead to much higher confidence ratings than what is true (Koriat, Lichenstein & Firschoff, 1980).

Throughout the review of the literature, it is evident that there are inconsistencies in the way that individuals respond under pressure and in the presence of bias. One explanation for the discrepancy is personality, which is yet to be considered in this line of research. This paper will investigate the effect that impulsivity, stubbornness and the need for closure can have on the way that individuals respond in decision making and change of mind tasks.

Impulsivity

Impulsivity is a trait that is discussed with reference to typical and pathological behaviours (Evenden, 1999). It can be defined as the tendency to deliberate less when deciding, particularly in situations that may be considered dangerous. Impulsive individuals are described as thrill seekers, who possess a number of other lower order traits including a lack of cognitive control, sensation seeking, risk taking, susceptibility to boredom, and unreliability (Tellegen, 1982; Cloniger, Pryzbeck & Surakik, 1991; Depue & Collins, 1999). In contrast, Buss and Plomin (1975) hypothesised that impulsive individuals do possess inhibitory control which means that they are able to resist immediate action and delay their behaviour. However, this is not an opinion that is popular in the literature.

More recently, impulsivity research has been focused on perseverance, premeditation and urgency, rather than the suggestion that impulsive individuals are cognitively impaired (Barratt, 1993). Similarly, in a factor analysis by Whiteside and Lynam (2001) four facets of impulsivity were identified; a lack of premeditation, a lack of perseverance, urgency and sensation seeking. Urgency is described as experiencing a strong desire to act, particularly when under negative affect. A lack of premeditation means that individuals act without considering the consequences. A lack of perseverance suggests that impulsive individuals are

reluctant to complete tasks that they feel are boring or unnecessary. Finally, sensation seeking refers to the tendency to engage in new activities that are potentially dangerous (Whiteside & Lynam, 2001).

Dickman (1990) proposed a different conceptualisation of impulsivity, to suggest that there are two types, functional and dysfunctional impulsivity. Functional impulsives are said to act rapidly in situations where it considered optimal, such as in a speeded reaction time task. Dysfunctional impulsives, in contrast act rapidly when it is suboptimal. In a series of studies, Dickman illustrates that individuals who are high in functional impulsivity will engage in a behaviour without first deliberating only if necessary to the situation. In contrast to this, dysfunctional impulsives appear to lack the ability to engage in slow behaviour, and therefore lack inhibitory control (Dickman, 1990).

Due to the urgent behavioural tendencies of an impulsive individual, impulsivity has been studied in relation to the SAT and decision making. Zermatten, Linden, d'Acremont, Jermann and Bechara (2005) investigated the presence of the four facets of impulsivity (identified by Whiteside & Lynam, 2001), in decision making, using the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio & Anderson, 1994). The results revealed that impulsive individuals who were high in a lack of premeditation took much longer to adjust to the task conditions and failed to make informed and accurate decisions. The IGT was considered to represent a real-life decision process, as well as being a measurement of reward and punishment. However, more recently, the reliability of the IGT has been questioned (Buelow & Suhr, 2009; Lin, Song, Chen, Lee & Chiu, 2013; Humphries, Bruno, Karpievitch & Wotherspoon, 2015). Humphries et al. (2015) found that the same participants achieve inconsistent results on each replication of the test. Therefore, the results from studies that have used this task should be treated with caution (Humphries et al., 2015). Franken and Muris (2005) replicated Zermatten's et al. (2005) study using the BIS and the BAS (Gray,

1987) and the DII as measures of impulsivity. The researchers conceptualised impulsivity as rash and spontaneous behaviour, and that there is no relationship between functional impulsivity and decision-making ability on the IGT (Franken & Muris, 2005). However, Vigil-Colet (2007) analysed this study further to find that the results of the DII were never considered. In the follow up investigation it was found that dysfunctional impulsivity was related to the results of the IGT.

Vigil-Colet (2007) investigated the relationship between decision-making using the balloon analogue risk-taking task (BART; Lejuez et al., 2002), and impulsivity, using the DII (Dickman, 1990). The objective of the BART is to gain as much money as possible, which can be achieved by continually pumping up a balloon. If the balloon pops, this results in all earnings being lost. In order to maximise their profits, participants are able to cash in their earnings prior to the balloon popping. This is therefore a test of balance between costs and benefits (LeJuez et al., 2002). There are three conditions, with a low, medium and high probability that the balloon will pop. The results revealed that there is no relationship between dysfunctional impulsivity and the decision processes needed to perform well in this test. Additionally, individuals who exhibited functional impulsivity would only make reckless decisions when this benefitted their performance. In this task, this was only seen when the probability of popping the balloon was low (Vigil-Colet, 2007).

Stubbornness

Although impulsivity may be related to the SAT and decision making, it is less clear the relationship that this has with change of mind. A more likely candidate to describe this is stubbornness. Stubbornness is a lay conceptualisation that can be linked to overconfidence, rigidity, dogmatism and resistance to change (Justin, Winman & Olsson, 2000; Oreg, 2003; Moore & Healy, 2008). Dogmatism is displayed by a person who is closed minded, which means that they are unwilling to change their belief system (Rokeach, 1954). Korn and

Giddan (1964) highlight dogmatics as being intolerant to change and having inflexible thought patterns. If new information is provided, a dogmatic individual is unwilling to accept that this may be a better option (Rokeach, 1954). Ehrlich and Lee (1969) extend this research to show that even when dogmatic individuals are shown that their beliefs are untrue, they can still remain rigid, and unchanging. The researchers suggest that there are five variables that influence this rigidity, including the source of the information, belief congruence, the centrality of this belief to the individual, the novelty of the information and the way in which the information is conveyed (Ehrlich & Lee, 1969).

A similar behaviour to dogmatism is known as the resistance to change (Oreg, 2003), which includes six key factors; a reluctance to lose control, cognitive rigidity, a lack of psychological resilience, intolerance to adjustment, preference to low levels of stimulation and a reluctance to change old habits (Wanberg & Banas, 2000). Cognitive rigidity is the most relevant factor in the study of stubbornness and has been compared alongside dogmatism to show that individuals who possess these traits are unwilling to change their mind (Jost, 2015). Oreg (2003) developed a resistance to change scale, which was used to predict students' approaches to changes of mind. Students with high scores on the scale were more unwilling to change their subject schedule once it had been finalised. In contrast to this, those who had low scores on the scale were willing to alter their schedules.

Most of what is known about resistance to change has come from organisational research. The resistance to change scale (Oreg, 2003) has been successful in predicting individuals who are likely to become negative and defensive when faced with organisational change. Piderit (2000) highlights that resistance to change can be explained by negative affect, cognitions and behaviour. One who is resistant to change can become angry and defensive when faced with the possibility of having to change their mind. Cognitively, one is centred around complaint and questions the necessity of the change, particularly when

considerable effort has already been applied. Vacchiano, Straus and Hochman (1969) supports the suggestion that dogmatic individuals are defensive and can be unwilling to change their mind. However, in addition to this, the researchers found that dogmatism is correlated with impulsivity (Vacchiano et al., 1969). This is an interesting cross over between two traits that have been conceptualised quite differently. Although, this finding has also been supported by Plant, Telford and Thomas (1965). However, Nidorf and Agrabite (1968) imply that stubborn individuals are inhibited as opposed to spontaneous and are unlikely to share a relationship with impulsivity.

The Need for Closure

The need for closure (NFC) is a personality trait that is conceptually related to both impulsivity and stubbornness. The NFC is characterised by the desire to have cognitive closure, which means that one wishes to have immediate answers to their questions, even if this answer is not correct (Krugalinski, 1989). Additionally, individuals who are high in the NFC are driven by the need for predictability and for situations to be well structured. The NFC in individuals can be enhanced when they are placed under a time pressure, where there may be an upcoming deadline, or a participant is forced to respond within a certain time frame in rapid-response tasks. Moreover, if a task is seen as boring, the NFC can be enhanced further, which indicates that less information will be accumulated by the individual before a response is elicited (Krugalinski, 1989). This finding has also been supported by Krugalisnki and Freund (1983) and Jost (2015). Empirically, participants have been found in an impression formation task to make impressions of others based on the information that is presented to them first, while disregarding any additional information (Krugalinski & Freund, 1983). Similarly, Bratowski (2010) investigated how those who are high in the NFC will make attributions about others. The participants were placed into two conditions and were either given positive or negative information about a person. Following this, they were then

supplied with additional information to contradict the initial information. Those who were high in the NFC did not take this new information into consideration and would make their judgements of the person based only on the first set of information that they received (Bartowski, 2010).

Choi, Koo, Choi and Auh (2008) studied the NFC in relation to advertising and marketing research. The study involved participants choosing which items they preferred from the different product categories. Participants were encouraged to navigate the 'website' and choose between phones, laptops and digital cameras. Participants who were high in the NFC did not utilise the search function on the 'website' and chose products that were in the first and only category they looked at, whereas those who were low in the NFC would consider many more options before making their choice (Choi et al., 2008).

Jost (2015) indicates that those who are high in the NFC can also exhibit resistance to change. Congruent with stubbornness, an individual who is high in the NFC is unlikely to change their mind once the initial decision has been made, and closure has been found. However, this resistance to change is mediated by different factors. Jost explains that those who are high in the NFC do not like situations that are ambiguous, or to ruminate once a decision has been made. This can result in decisions being made rapidly, and a rigidity in thinking afterwards that is difficult to alter. Therefore, in contrast to this, individuals who are low in the NFC are likely to spend more time making decisions, and are less determined to achieve closure (Evans, Rae, Bushmakin & Brown, 2017). This demonstrates that one who is low in the NFC is less focused on certainty and will be more willing to change their mind or beliefs when exposed to new information.

Furthermore, Krugalinski and Webster (1996) discuss that individuals with a high NFC can make rapid judgements, due to setting a low decision threshold, which means that only a small amount of evidence is required in order to decide. Decisions made rapidly are

prone to error, however, the individuals who are high in the NFC do not utilise the change of mind options, as this threatens to reduce the feelings of closure (Krugalinski & Webster, 1996). Webster (1993) and Krugalinski, Webster and Klem (1993) uncovered that those who display high NFC are often highly confident in their responses. This is an interesting finding which contests much of what is known about confidence judgements. Confidence is consistently described as being high when more information has been acquired, rather than less. The behaviour demonstrated by those who are high in the NFC is anomalous (Webster & Krugalinski, 1994).

The need for closure has been found to be positively correlated with both impulsivity and stubbornness. Webster and Krugalinski (1994) hypothesised that those who are high in the NFC would demonstrate the same closed-minded behaviours as dogmatism, which means that they would be unwilling to change their mind when exposed with new information. The researchers found support for this, indicating that there is a small positive correlation between dogmatism and the NFC. Likewise, impulsivity is also predicted to be positively correlated with the NFC. Those who are high in the NFC and impulsivity are expected to want closure in their responses rapidly, and do not wait for additional information before deciding (Cantwell & Baker, 1992).

Evans et al. (2017) indicate that both impulsivity and the NFC are constructs that favour speed of decision making, which suggests that both set a low decision threshold and require less information in order for a decision to be made. The researchers aim to find a relationship between the NFC and the speed accuracy trade off, which is measured by the use of the LBA model. In this experiment participants were to complete a perceptual discrimination task, where squares appeared on the screen that were either black or white. Using two keys on the keyboard, participants were to respond with either a “D” (dark), or “L” (light) to indicate the predominant shade that had appeared on the screen. In one

condition, participants were encouraged to do this as quickly as possible, and in the second condition, the participants were told to take their time and be as accurate as possible, known as the accuracy condition. The results revealed that in the accuracy condition, the participants who showed high NFC could not be differentiated from those low in the trait, simply based on their response pattern. However, when the participants were forced to respond rapidly, the response RT and the NFC were strongly correlated, therefore demonstrating that the NFC is related to the making of a snap decision. (Evans et al., 2017).

Aims and Hypotheses

The aim of the present research is to gain an understanding of the associations between individual differences and the making of a snap decision, change of mind, and the confidence that one feels in their decision making. Participants will engage in a two-step response. First, participants will decide if a word is “old” (from the study list), or “new”. The second response will involve rating their confidence, and an option will be given to change their mind. The individual differences of interest include impulsivity, as measured by Dickman’s impulsivity inventory (DII), the abridged need for closure scale (NFCS; Roets & Van Hiel, 2007), and stubbornness as measured by the cognitive flexibility inventory (CFI; Dennis & vander Wal, 2010). Several hypotheses have been developed based on the review of the literature.

1. It is hypothesised that both functional and dysfunctional impulsivity will be negatively correlated with RT and accuracy in their initial response. This means that those who are impulsive will have a fast RT and will be lower in accuracy.
2. Stubbornness will be positively correlated with RT and accuracy for the first response. This means that stubborn participants are expected to take their time with their initial response, which will increase their accuracy.
3. It is expected that the NFC will be negatively correlated with RT and accuracy for the

first response. Those who exhibit high NFC have been found to set low decision thresholds and are therefore expected to have a fast and inaccurate first response.

4. Functional impulsivity will be positively correlated with change of mind at the second response. Impulsive individuals are expected to make a number of errors but be aware of them and be more willing to correct their errors. Therefore, individuals who exhibit high functional impulsivity will have an improved accuracy at time 2.
5. Dysfunctional impulsivity will be negatively correlated with change of mind at the second response. Due to the lack of perseverance shown by these individuals, it is expected that there will be a low use of the change of mind option, or inappropriate reversals/confidence judgements.
6. There will be a negative relationship between the NFC and change of mind, nor stubbornness and change of mind. Due to the rigidity of their thinking patterns, those who are high in these traits will be unwilling to change their mind. Therefore, it is expected that that there will be no improvements in accuracy from time 1 to time 2 for the those who are high in the NFC, or for stubbornness.

Method

Participants

Fifty-two participants from the University of Tasmania participated in this study. The data from 3 participants was removed due to the task crashing before sufficient data could be obtained, and due to 1 file becoming corrupt and thus unreadable. The analysis therefore consisted of 49 participants. Participants attended 2 x 1-hour sessions, with first year undergraduate students receiving 2 hours of course credit. Other participants had the option to receive $15/hr remuneration for their time.

Materials

Three personality inventories were administered, the Dickman’s Impulsivity

Inventory (DII; Dickman, 1990), the Cognitive Flexibility Inventory (CFI; Dennis & Vander Wal, 2010) and the Need for Closure Scale (NFCS; Webster & Krugalinski, 1994); Roets & Van Hiel, 2007). The DII is a 23-item scale, answered as true/false. It contains two subscales with 11 items assessing functional impulsivity (questions; 1, 3, 5, 7, 9, 11, 13, 15, 17, 19 and 21) and dysfunctional impulsivity (2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 and 23). True answers were given a categorical value of '1', and false answers were rated as '0'. The scale has good reliability for both functional $\alpha = .83$, and dysfunctional $\alpha = .85$. In addition, the scale has good external validity when compared with the BIS-11 (Patton, Standford & Barratt, 1995) and the I-7 (Eysenck, Pearson, Easting & Allsopp, 1985).

The CFI is a scale that was developed in order to measure those with cognitive rigidity and closed mindedness, as displayed by stubborn individuals. The scale contains 20 items, measured on a 7-point likert scale from strongly disagree to strongly agree, with low scores indicating high stubbornness. Questions 2, 4, 7, 9, 11 and 17 are reverse scored. The CFI has been found to have excellent reliability ($\alpha = .92$), and good external validity when compared with alternative scales; the cognitive flexibility scale (Martin & Rubin, 1995) and the attributional style questionnaire (Peterson et al., 1982). The psychometric properties of the CFI have been further validated by Johnson (2016), who supported the scale's ability to identify stubbornness.

The abridged version of the NFCS was used in this project (Roets & Van Hiel, 2007). The scale contains 15 questions, answered on a 6-point likert scale, and there are no items that are reversed scored. The scale has high internal consistency ($\alpha = .84$), and acceptable discriminant and convergent validity, when compared with other measures (e.g., impulsivity, dogmatism, fear of invalidity).

The memory task was written in python (v.26) and run on an IBM compatible desktop, with a QWERTY keyboard. The test instructions were written in Arial 48, and were

displayed on a 24-inch motor with 1920 x1080 pixel resolution.

The task used 2, 069 verbs and nouns in the experimental (1, 536) and practice trials (533). The words were rated for frequency (min = 1, max = 314, 323, med = 469) and contextual diversity (min = 1, max = 8, 363, median = 294) by the American English Brysbaert and New (2009) norms. Imageability scores (min = 183, = max = 667, median = 506) and word concreteness were sourced from the Medical Research Council Psycholinguistic Database (Coltheart, 1981). In addition, each word was between 4 and 7 letters in length.

Participants attended 2 x 1-hour sessions. In the first, participants completed 6 recognition memory study test cycles. This was used as a way to prepare participants for the second session, in order to reduce the amount of noise seen in the data due to misunderstanding of the task. In the experimental session, participants completed 16 study test cycles. Three hundred and twenty-four words were used in each participant's initial practice session. A practice cycle of 24 words (12 study, 12 new words) and 6 full length trials were completed (28 study words, 50 test words). The word list for each participant differed between session 1 and 2, to prevent learning effects. An even number of test cycles was used in order to counterbalance for word frequency, and the proportion of target words that were used as lures.

In session 2, a random selection of 866 words were used in each participant's study-test cycle. Twenty-four words were used in the preliminary list, which was used to remind participants of the correct key pressing sequence. Comparable to the first session, there were then 16 recognition memory cycles, where 28 words were used in the study list, and 50 in the test list. Four foil words were added to each study list in order to control for primacy and recency effects. Two words were at the start of each list and two at the end. Two of these words were added to the list but were not analysed. Therefore, each test list contained 24

target/old words, and 24 new words that were analysed.

Procedure

Participants were seated at a desk containing the computer monitor, and were first given the three personality inventories, which they could complete at their own pace. Following this, participants were then taken through the response training session. Additionally, participants were asked to wear noise cancelling head phones, in order to reduce distractions and discomfort when repeating the study list aloud. Study words would each appear on the screen for one second, with a half a second pause of a blank screen between words. Between the deliverance of the study list and the experimental phase, there was a 15 second interval. The task involved a two-stage response, with the first emphasising speed; where participants were to respond either “old” or “new” to the stimulus. The second decision emphasised accuracy, where participants were given 5 seconds to rate their accuracy or change their mind. Six keys on the keyboard were used in order to execute the response. Half of the participants were to respond old with their right hand (“,”), and new with their left (“c”). The other half responded old (“c”), new (“,”). The second response confidence ratings were also different depending on the condition. The required sequence was alternated between participants to counterbalance between handedness. For subjects who used their right hand to respond “old,” the confidence ratings were; high confidence old (“.”), low confidence old (“/”), high confidence new (“x”), low confidence new (“z”). Participants were to rate their response as either high or low confidence for old (“.”, “/”), or could change their mind, by using the “new” confidence ratings (“x”, “z”). For the remaining participants, the left hand was used to make an old response (“c”). The confidence ratings were therefore, high confidence old (“x”), low confidence old (“z”), high confidence new (“.”), low confidence new (“/”). The stimuli were presented in the centre of a white screen in black writing. The stimulus turned blue once the first response had been made, or after 750ms, whichever came

first. If more than 750ms was taken, “TOO SLOW” flashed across the screen in red writing, and no response would be recorded. Similarly, if the response was made before 250ms, “TOO FAST” flashed across the screen, and this too would be recorded as an error. Participants were then allowed 5 seconds to make their confidence response. If participants made this response before 200ms “CONFIDENCE RESPONSE TOO FAST” would flash across the screen. This was merely to emphasise the importance of accuracy for this second response as the response was still recorded, and the participants were still awarded points if the response is correct. If a participant failed to make the first response, but makes the second, “WRONG RESPONSE PAIR” would flash across the screen, and this was recorded as a no response for both the first and second decision. In addition, if no response was made within 5 seconds “TIME LIMIT EXCEEDED, NO RESPONSE RECORDED” flashed across the screen. Between the presentation of stimuli, “PRESS SPACEBAR TO CONTINUE” would appear on the screen, to prompt participants to continue.

The practice session began with instructions about how to correctly navigate the response options. For example, the word “new” would appear to prompt participants to click either the “c” or the “,”. Following this, participants then completed 6 full length study-test cycles, which took roughly 40 minutes to complete. Participants then returned for a second one-hour session. This was anywhere from a day to a week after the first session. Again, participants were provided with noise cancelling head phones and were given a chance to familiarise themselves with the key pressing sequence before completing a final practice run.

In order to motivate participants, accuracy feedback was provided after each response as a point system, and a total (out of 100%) was given at the end of each cycle. This was based on participants speed, accuracy, confidence and the use of the change of mind option. The point system was calculated using brier rule (Brier, 1950), which is a quadratic function of the difference between forecast and outcome. Here the outcome can be coded as 1 if the

stimulus is “old” and 0 if the stimulus is “new”. Therefore, the forecast represents the participants confidence that the stimulus is old, which is used to calculate the points for each response. Consequently, responding high confidence old means there is 75-100% chance the stimulus is old; low confidence old, means that there is 50-75% the stimulus is old; low confidence new, means there is 25-50% chance that the stimulus is old; and high confidence new, means there is 0-25% chance that the stimulus is old. The middle of each range was taken (e.g. 87.5% for high confidence old) and was substituted into the brier function ($1-(87.5-1)^2 = 0.979$). The low confidence brier is .604, which was subtracted from each score, to ensure that a low confidence error response would elicit a score of 0. Each score is then multiplied by 2000 to scale them to larger values. The points for the confidence ratings are therefore 750 for high confidence, 500 for low confidence, 0 for low confidence error, and -750 for a high confidence error. This rule guarantees that participants get maximum points when their confidence is matched with their accuracy. As displayed in Table 1, if a participant is simply guessing (accuracy 50%), and uses the high confidence response each time, their eventual score would be 0. The addition of the scores following each response was to help participants visualise their accuracy and motivate them to maximise it.

Table 1: *Participants expected scores according to the brier rule.*

P(correct)	*P(Error)*	*High Confidence*	*Low Confidence*
1	0	750	500
0.95	0.05	675	475
0.90	0.10	600	450
0.85	0.15	525	425
0.80	0.20	450	400

Table 1 Continued:

P(correct)	*P(error)*	*High Confidence*	*Low confidence*
0.75	0.25	375	375
0.70	0.30	300	350
0.65	0.35	225	325
0.60	0.40	150	300
0.55	0.45	75	275
0.5	0.50	0	250

Results

The following analyses have been broken down into three parts. The first part will analyse the speed and the accuracy of the first decision response, to determine if this is consistent with the SAT. The data will then be examined taking into consideration the participants personality scores.

The second part of the analysis will address the second response, to determine if this is consistent with the findings from the Van Zandt and Maldonado-Molina (2004) reverse response model. There are multiple components to this section. Firstly, the accuracy of the response, the number of response reversals, and any improvement in accuracy will be looked at. Additionally, the RT of this second response, and any anomalous responses will also be examined. This data will then be compared with the participant's personality scores.

The third part of this analysis will be to discuss the appropriateness of the inventories, and to analyse if this sample is consistent with that of the normed data.

First Response

Participants old/new response for the first decision was analysed using a correlation

analysis in a BayesFactor package (Morey & Rouder, 2011). Participants average RT ranged from 450 to 900ms with an overall mean RT of 690ms. No correlation was found between functional impulsivity (r =- 0.054) or between dysfunctional impulsivity (r = 0.08) and reaction time. A weak positive correlation was found between the need for closure and RT $t(47) = 1.12$, $r = 0.16$, $p = 0.027$, and a weak negative relationship between stubbornness and RT $t(47) = -1.29$, $r = -0.18$, $p = 0.20$. Each relationship elicited a Bayes factor of less than 1 (see Table 2), indicating that there is greater support for the null being true.

Table 2: *First response RT relationship with the three personalities*

	r	*p*	*95% CI*		*BF*
			Lower Bound	*Upper Bound*	
Functional Impulsivity	-0.054	0.70	-0.33	0.23	0.30
Dysfunctional Impulsivity	0.08	0.54	-0.19	0.36	0.33
The Need for Closure	0.16	0.27	-0.13	0.42	0.48
Stubbornness	-0.18	0.20	-0.44	0.10	0.56

Secondly the accuracy of the first response was analysed. The accuracy of the sample ranged from 50-93%, with an overall mean of 68.51%. Weak positive correlations were found between functional and dysfunctional impulsivity and accuracy (see Table 3). This means as the personality trait increases, as does the accuracy. All 4 personality types had a

Bayes factor of below 1, which represents greater support towards the null hypothesis. It was hypothesised that stubborn individuals would have a greater accuracy on the first response, therefore, a secondary analysis was completed on participants who achieved a mean accuracy greater than 80%. A moderate relationship between stubbornness and accuracy (see Figure 1), and functional impulsivity was found. However, the change in belief is negligible due to the very small sample size.

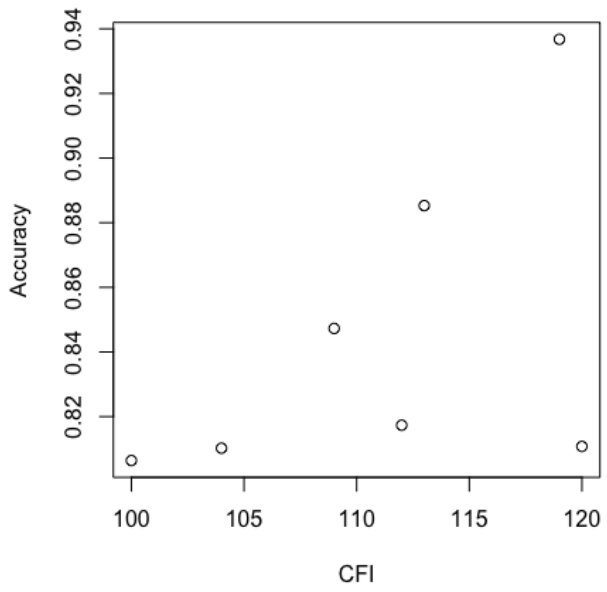

Figure 1: *Relationship Between Stubbornness and first response accuracy when above 80%.*

Table 3: *Correlation between personality and accuracy of the first decision response*

	r	*p*	*95% CI*		*BF*
			Lower Bound	*Upper Bound*	
Functional Impulsivity	0.14	0.34	-0.15	0.40	0.42
Dysfunctional Impulsivity	0.25	0.08	-0.03	0.49	0.99
The Need for Closure	-0.065	0.65	-0.34	0.22	0.31
Stubbornness	0.025	0.87	-0.25	0.34	0.29

Second Response

Participants old/new confidence judgement and change of mind response was analysed with a correlation analysis. There are multiple components that have been addressed in this part of the analysis.

Firstly, a large proportion (87%) of participants responded before 200ms for at least one of the confidence judgements. Van Zandt and Maldonao Molina (2004) indicate that a second response that is made before this time is too quick, as not enough time has been allowed for additional information to be accumulated. This resulted in the overall mean RT of 380ms. Overall, no relationship was found between the speed of the second response and the personality of the participants (see Table 4). Therefore, a secondary analysis was conducted specifically on the participants who responded between 100 and 300ms. The results indicate that there is a moderate negative relationship (r = -.318) between dysfunctional impulsivity

and the RT for the second response. However, again the Bayes Factor for this is 0.775, which indicates greater support for the null hypothesis that personality does not influence participant's RT.

Table 4: *Relationship between personality and RT of the second response*

	r	*p*	*95% CI*		*BF*
			Lower Bound	*Upper Bound*	
Functional Impulsivity	-0.17	0.25	-0.43	0.12	0.50
Dysfunctional Impulsivity	-0.14	0.32	-0.40	0.14	0.42
The need for closure	0.13	0.37	-0.15	0.39	0.40
Stubbornness	-0.08	0.58	-0.35	0.25	0.32

The second response involved a confidence judgement based on the first decision that could be high or low. The correlation analyses demonstrate that there is a weak relationship between the use of high confidence and stubbornness ($r = 0.24$, $BF = 0.93$), and the NFC ($r = -0.18$, $BF = 0.57$), however, no relationship was found between the use of high confidence and functional impulsivity ($r = 0.09$, $BF = 0.345$), and dysfunctional impulsivity ($r = 0.12$, $BF = 0.38$). Sixteen percent of participants responded that they were high in confidence with every decision, 18% never used the low confidence option, and 45% responded with high confidence more than 80% of the time. It was found that there was no relationship between

functional impulsivity or the need for closure and participants who always utilised the high confidence option (see Table 5); A weak relationship was found between stubbornness and high use of the high confidence option, and a moderate relationship was found between dysfunctional impulsivity and the use of the high confidence option more than 80% of the time. However, the Bayes Factor indicates only equivocal support for these relationships.

Table 5: *Relationships between personality and participants who responded "high confidence" on 80% of trials*

	r	*p*	*95% CI*		*BF*
			Lower Bound	*Upper Bound*	
Functional Impulsivity	0.086	0.67	-0.30	0.45	0.38
Dysfunctional Impulsivity	0.30	0.12	-0.082	0.62	0.92
The need for closure	0.0013	0.99	-0.37	0.38	0.36
Stubbornness	0.17	0.38	-0.22	0.52	0.48

Past literature indicates that participants are aware when they have made an error and that they are willing and able to change their mind to correct this decision. A weak relationship was found between the NFC and the number of response reversals (r = 0.13, *BF*

= .39), and a weak relationship between stubbornness and the number of response reversals (*r* = 0.10, *BF* = 0.35). No relationship was hypothesised for this personality type. No relationship was found between functional impulsivity and response reversals (*r* = 0.032, *BF* = 0.29) nor dysfunctional impulsivity (*r* = -0.049, *BF* = 0.29). Given the low Bayes Factor, support for the null can neither be affirmed or rejected. Seven participants did not change their mind on any of the trials, and a number of participants used this option sparingly. For these participants, a weak negative relationship was found between dysfunctional impulsivity and the number of response reversals (*r* = -0.20, *BF* = 0.52), and the need for closure (*r* = -0.23, *BF* = 0.56). A weak positive relationship was found between stubbornness and the number of response reversals (*r* = 0.12, *BF* = 0.46) and no relationship was found between functional impulsives and limited use of the change of mind function. In contrast, a number of participants reversed their response on more than 20% of the test cycles. In contrast to hypothesis 6, a strong positive relationship was found between the NFC and a high use of the change of mind option (*r* = 0.52, *BF* = 1.86) and a moderate positive relationship for dysfunctional impulsivity (*r* = 0.35, *BF* = 0.79) (see Figure 2). For the NFC, the Bayes factor obtained is greater than 1, which is negligible, and thus shows stronger support towards the null hypothesis.

The accuracy of the second response ranged from 49% to 96.97%. The mean accuracy for the sample was 71.8%, with 82% of participants showing some improvement in their accuracy from time 1. With reference to the participants personalities, no relationship was found between functional impulsivity and improvement in accuracy (*r* = -0.07, BF = 0.31), a weak negative relationship between dysfunctional impulsivity and improvement in accuracy (*r* = -0.145, *BF* = 0.43), a weak negative relationship between the NFC and improvement in accuracy (*r* = -0.145, *BF* = 0.47) and no relationship between stubbornness and the improvements in accuracy (*r* =0.052, *BF* = 0.300). The Bayes Factor for each relationship is

close to a third, which indicates that the sample size is not great enough to determine the nature of the relationship.

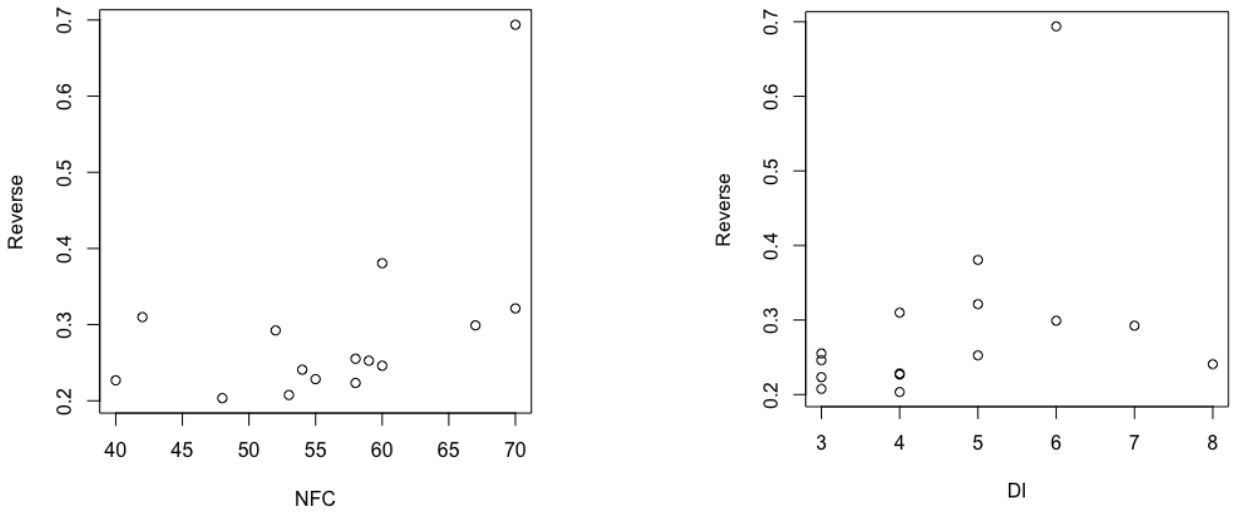

Figure 2: *Relationships between personality and participants with a high number of response reversals*

The Personality Inventories

The participants personality inventory scores were compared with past research normed with a comparable sample of participants. Table 6 shows the population mean and standard deviation for the norm referenced groups. The scores obtained by this sample were consistent with the norms found for the Dickman's Impulsivity Inventory. Although, this sample appeared to have a greater number of dysfunctional impulsives than the comparison paper (Yeomans, Leitch, & Mobini, 2008). The participants in this sample had lower overall scores on the need for closure scale than the compared group, but a similar range was found. Only a very restricted range was found for the cognitive flexibility inventory, with higher

scores on this scale than what was expected, given that low scores indicate stubbornness. This resulted in difficulties differentiating between participants who exhibit this trait.

Table 6: *Comparison of inventory scores with mean referenced groups*

	x	*Min*	*Max*	$\bar{x}$	*SD*
DII Total	9.70	5	16	8.5	0.8
Functional Impulsivity	4.72	1	8	4.75	0.55
Dysfunctional Impulsivity	4.96	3	10	3.68	0.5
The Need for Closure	57.04	37	74	69.8	1.19
Stubbornness	104.50	80	129	93	15.76

Discussion

The present study aimed to investigate the relationship between personality and making a snap decision, and the likelihood that participants will be willing to change their mind or make an appropriate confidence judgement. Hypothesis 1, 2 and 3 each addressed the three personality traits (impulsivity, stubbornness and the NFC) and the first decision RT and accuracy. Hypothesis 1 and 3 predicted that participants, who were high in functional and dysfunctional impulsivity, and the need for closure, would have a fast RT and a low accuracy, and hypothesis 2 predicted that individuals who were high in stubbornness would have a slower RT, but would have a higher accuracy. Limited support was found for these hypotheses.

The remaining hypotheses addressed the second response and if there were improvements in accuracy. Hypothesis 4 predicted that due to the number of errors made by functional impulsives, participants will be more likely utilise the change of mind option and improve their accuracy. Hypothesis 5 predicted that dysfunctional impulsives would respond inappropriately to the confidence judgement, which would imply guessing. Therefore, it was predicted that there would be no improvement in accuracy. Hypothesis 6 predicted that due to the rigidity of thinking in individuals who are high in the NFC and stubbornness, there would be no relationship between each personality and the number of mind changes. Subsequently, there will be no improvement in accuracy. Again, only limited support was found for these hypotheses.

The mean RT was analysed with reference to the participant's personalities. The frequentist approach found there to be no correlation between functional or dysfunctional impulsivity and RT. This suggests that there is no difference in the decision threshold set by these participants. However, this is equivocal evidence, which requires a greater sample size to determine the nature of the relationship. Additionally, a weak positive relationship was found for the NFC and mean RT, and a weak negative relationship between stubbornness and RT. However, again the sample size is not great enough to determine if this relationship is meaningful.

Similarly, there were limited relationships between the personalities on the first decision accuracy. The need for closure and stubbornness both showed no correlation with accuracy, and functional and dysfunctional impulsivity showed weak to weak-moderate correlations with accuracy. This is in contrary to the hypotheses which predicted a negative relationship. Stronger relationships could be seen when the participants who were responding unusually were specifically analysed, for example, those who responded with accuracy

greater than 80% for the first response. However, the change in belief is negligible due to the small number of participants who responded in this way.

To date, there is limited research regarding RT and personality traits. Research by Dickman (1990), Vigil-Colet (2007) and Evan's et al. (2017) have each found support to suggest that impulsive individuals and those high in the NFC respond rapidly in SAT tasks. However, results to support the findings of this paper also exist. Dickman (1985) found impulsive participants were more accurate in a rapid card sorting decision task, compared to those who were low in the trait. This finding was supported by Dickman and Meyer (1988), who found there to be no cost to accuracy in the matching familiar figures test for children who were rated as impulsive. However, the relationship was not found in all conditions. In addition, Lozano, Hernandez and Santacrew (2015) failed to find a relationship between impulsivity and the SAT suggesting that individual differences do not influence response patterns. Other research has looked specifically at decision tasks where participants are forced to respond before a specific time. Karsilar, Simon, Papadakis and Balci (2014) propose that differences in RT can be seen in accuracy emphasis, where individuals have the opportunity to choose their optimal decision threshold. However, in perceptual decision tasks such as this one, the threshold is lowered for everyone within the same time constraint (Karsilar et al., 2014). It is possible that for time 1, this restricted range has led to ceiling effects.

Hypothesis 4 was not supported. No relationship was found between functional impulsivity and the number of response reversals overall, nor for those that changed their mind greater than 20% of the time, or for those who did not utilise this option at all. Dickman (1990) proposed in his research that individuals who possess functional impulsivity will act optimally in tasks such as this and will be able to make quick and effective decisions. Fundamentally, functional impulsives can act on a snap decision accurately. Therefore, a

possible explanation for null results here is that only limited errors were made by those high in functional impulsivity at time 1, reducing the opportunity for them to change their mind.

Alternatively, the dual process theory of decision making explains that some individuals make decisions automatically and intuitively, whereas others spend more time to deliberate the costs and benefits of an outcome, to obtain high reward (Krajibich, Bartiing, Hare & Fehr, 2015). In the present study, the aim for the participants was to increase the points accumulated, which was achieved by improving their accuracy. For participants who were cognitively invested it is possible that this was considered reward enough. However, the reward of increasing the points may not have been enough for many participants, particularly those who exhibit impulsive tendencies. In turn, a more enjoyable reward may have been completing the task quickly (Wittmann & Paulus, 2008).

Limited support was found for hypothesis five. Overall, there was no relationship found between dysfunctional impulsivity and the number of response reversals. A weak negative relationship was found between dysfunctional impulsivity and participants who rarely changed their mind throughout the study, as well as a weak positive relationship between dysfunctional impulsivity and a high use of the change of mind option. Research by Claes, Vertommen and Braspenning (2000) indicate that the reckless response pattern that identifies dysfunctional impulsivity is apparent only when the individual finds a task to be difficult. Presently, it is possible that the participants who have found the task difficult, who exhibit dysfunctional impulsivity have fallen in the bottom 10% of response reversals. And those that did not find the task difficult, were able to perform the task optimally, and correct initial errors. However, it is important to consider the small Bayes Factor elicited, of less than 1 for each relationship. This demonstrates equivocal evidence; thus, a greater sample size is required to determine the true nature of the relationship.

In addition, there was an unusual use of the confidence options. In particular, a

number of participants never used the low confidence option. However, no relationship was found between this response pattern and personality. Anecdotal evidence suggests this response pattern was not a result of high confidence, but the participants inability to manipulate their fingers correctly on the keyboard. Researchers such as Lachnit and Pieper (2007) and Klotz et al. (2011) support this evidence, suggesting that the dexterity and the fine motor control of each finger differs. We have the most control over the index finger, and the dexterity of each finger declines down to the little finger. In the present study, participants placed their ring finger on the low confidence option, therefore potentially limiting their ability to respond in this way.

Partial support was found for hypothesis 6. Overall a weak positive relationship was found for both the NFC and stubbornness when correlated with the number of response reversals. This is contrast with what was predicted, however, given the low Bayes factor, stronger support for the null still remains. It was expected that there would be no use of the change of mind option by participants. For those participants who did use the change of mind option sparingly, a weak negative relationship was found between response reversals and the NFC. This means that as the NFC increased, the number of response reversals decreased, which is in support of the hypothesis. However, a weak positive correlation was found between stubbornness and the limited number of response reversals.

In contrast to this, the participants who utilised the change of mind option regularly were found to have a strong positive relationship with the NFC, but no relationship with stubbornness. This means that as the need for closure increased, as did the number of response reversals. This in contrast to the findings from Krugalinski and Freund (1983), Krugalinksi (1989), Krugalinski and Webster (1996), Bratowski (2010), and Evan's et al. (2017), who indicate that once a decision has been made, those who are high in the NFC will be unwilling to change their mind. Krugalinski (2004) indicates that there are different

factors that can lead to high need for closure. Some individuals may be affected by dispositional factors and others by contextual features, such as a time pressure, fatigue and boredom. An individual may score high on the need for closure scale, but if the task is not deemed important enough for these factors to be realised, the costs and benefits of achieving closure will be redundant (Viola et al., 2015).

In addition, different participants may have different motivations which can alter the way that the NFC is displayed in individuals. Roets (2007) suggests that if the task is considered to be intrinsically rewarding to the participant than the NFC is less likely to negatively affect the response pattern in the task. With consideration to this, it is possible that the participants who willingly changed their mind at time 2 were doing so in order to enhance their overall score in the task, thus reducing the effect that their NFC was having on them.

Alternatively, the concept of the NFC has been divided into two components, one being seizing, and the other freezing. Seizing refers the rapid decision, which was hypothesised to be seen at time 1, and the freezing refers to the refusal to change one's mind once a decision has been made (Krugalinski & Webster, 1994). The seizing and freezing have been identified as separate constructs, which means that an individual can seize information rapidly, but not be completely rigid and unwilling to change their mind. Neuberg, Judice and West (1997) introduce the argument that the need for closure scale does not delineate between the two constructs. The researchers developed a two-factor scale which addressed the close-mindedness aspects of the need for closure as well as the need for quick decisions component. In follow-up research for the use of Neuberg's et al. (1997) scale, decisiveness was found to be negatively correlated with closed mindedness, similar to what has been found in this study. Therefore, in the future, the use of a multidimensional scale might be more appropriate to differentiate between participants.

The present study has been loosely based off the recognition memory study

completed by Hickey (2017). Hickey found that a large number of participants refused to change their mind and remained high in confidence throughout. The same pattern of results was found in this study, although personality was additionally examined to seek an explanation for the rigidity of the results. However, a key limitation was the low sample size acquired. For each of the hypotheses, limited evidence was found to suggest that personality does have some relevance in how individuals make quick decisions, and how they then change their mind or rate their confidence. Due to equivocal evidence, it cannot be determined if the findings from this study are meaningful. If this study were to be replicated in the future, a much larger sample of participants should be used in order to be able to confirm or deny the null hypothesis.

A second limitation was the use of the CFI. The CFI has undergone factor analysis, and has been confirmed to be psychometrically sound, however, it was developed for a pathological demographic. “Stubbornness” is a little studied phenomenon, therefore, there were difficulties in gaining access to an inventory appropriate for this purpose. Although, Johnson (2016) discussed that the CFI is an adequate measure that can be used in the identification of stubbornness. For the present study, however, it was difficult to differentiate between participants. Therefore, the scale is perhaps inappropriate for a university sample. In future replications of this research, it would be advised to develop a stubbornness measure to specifically target the attributes of a stubborn individual.

The present study has shown some support that different personality traits can influence the way in which an individual makes a snap decision, rates their confidence and is able to detect and correct an error. Due to the small sample size, however, only tentative recommendations can be made for the future directions. Evans et al. (2017) were able to model the NFC into the LBA in order to make predictions regarding the decision-making process for this personality type. As can be seen in the results of this study, little difference

was found between speed and accuracy of the first response among the three personality types. However, there were differences in the way each personality utilised the change of mind option. In future experimental designs, it may be beneficial to model each of the personality types into the reverse response model, to be able to determine the probability that an error will be detected and then corrected by participants with different personalities.

To reiterate, this study has been able to show limited support that personality traits do have some influence on the way that individuals make decisions and change their mind. The results show that it is difficult to differentiate between participants for the first response, due to the time pressure in which they are required to respond. This has led to a restricted range and ceiling effects. The second response showed stronger relationships between the personality types, particularly for the NFC and dysfunctional impulsivity, which shows some support that personality has influenced the way that participants have approached this second response. Although, due to the low power of this study, a null result was achieved. It is recommended that the study be replicated in the future with a greater sample size to increase power, in order to determine if the null result replicates, or if the correlations that were seen, are meaningful.

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Appendix A

UNIVERSITY of TASMANIA

Division of Research

27 September 2018

Professor Andrew Heathcote
C/- Psychology, University of Tasmania

Sent via email

Dear Professor Heathcote:

REF NO: H0016517
TITLE: The Effects of Snap Decision Making on Episodic Recognition Memory

This is to confirm that the following amendment was approved by the Chair of the Tasmania Social Sciences Human Research Ethics Committee on 11/4/2018:

-Ellen-Jane Hickey is no longer on this project, Bryana Frazer will now take the student role
-Participants will be required for two one-hour sessions
-Administration of three personality inventories

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the National Statement on Ethical Conduct in Human Research (NHMRC 2007, updated May 2015).

Should you have any queries please do not hesitate to contact me on (03) 6226 2764.

Yours sincerely

Ailin Ding

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Appendix B

Dickman's Impulsivity Inventory

Please read the following statements and tick the box that you feel most applies to you

		True	**False**
1	I don't like to make decisions quickly, even simple decisions, such as choosing what to wear, or what to have for dinner		
2	I will often say whatever comes into my head without thinking first		
3	I am good at taking advantage of unexpected opportunities, where you have to do something immediately, or you lose your chance		
4	I enjoy working out problems slowly and carefully		
5	I am uncomfortable when I have to make up my mind rapidly		
6	I frequently make appointments without thinking about whether I will be able to keep them		
7	I like to take part in really fast paced conversations, where you do not have much time to think before you speak		
8	I frequently buy things without thinking about whether or not I can really afford them		
9	Most of the time, I can put my thoughts into words very rapidly		
10	I often make up my mind without taking the time to consider the situation from all angles		
11	I don't like to do things quickly, even when I am doing something that is not very difficult		
12	Often, I do not spend enough time thinking over a situation before I act		
13	I would enjoy working at a job that required me to make a lot of split second decisions		
14	I often get into trouble because I do not think before I act		
15	I like sports and games in which you have to choose your next move very quickly		
16	Many times the plans I make don't work out because I haven't gone over them carefully enough in advance		
17	People have admired me because I can think quickly		
18	I rarely get involved in projects without first considering thre potential problems		

19	I have often missed out on opportunities because I couldn't make me mind up fast enough		
20	Before making any important decisions, I carefully weigh the pros and cons		
21	I try to avoid activities where you have to act without much time to think first		
22	I am good at careful reasoning		
23	I often say and do things without considering the consequences		

Appendix C

Cognitive Flexibility Inventory

Please use the scale below to indicate the extent to which you agree or disagree with the following statement

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

1. **I am good at sizing up situations**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

2. **I have a hard time making decisions when faced with difficult situations**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

3. **I consider multiple options before making decisions**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

4. **When I encounter difficult situations, I feel like I am losing control**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

5. **I like to look at different angles**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

6. **I seek additional information not immediately available**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

7. **When encountering difficult situations, I become so stressed that I can not think of a way to resolve the situation**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

8. **I try to think about things from another person's point of view**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

9. **I find it troublesome that there are so many different ways to deal with difficult situations**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

10. **I am good at putting myself in other people's shoes**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

11. **When I encounter difficult situations, I just do not know what to do**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

12. **It is important to look at difficult situations from many angles**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

13. **When in difficult situations, I consider multiple options before I decide on how to behave**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

14. **I often look at a situation from different view points**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

15. **I am capable of overcoming the difficulties in life that I face**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

16. **I consider all the available facts and information when attributing causes to behaviour**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

17. **I feel I have no power to change things in difficult situations**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

18. **When I encounter difficult situations, I stop and try to think of several ways to resolve it**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

19. **I can think of more than one way to resolve a difficult situation that I am confronted with**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

20. **I consider multiple options before responding to difficult situations.**

1.		**2.**		**3.**		**4.**		**5.**		**6.**		**7.**	

Appendix D

15 Item Need for Closure Scale

Read each of the following statements and decide how much you agree with each according to your attitudes, beliefs, and experiences. Please respond according to the following 6-point scale:

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

1. **I do not like situations that are uncertain**

1.		2.		3.		4.		5.		6.	

2. **I dislike questions which could be answered in many different ways**

1.		2.		3.		4.		5.		6.	

3. **I find a well-ordered life with regular hours suits my temperament**

1.		2.		3.		4.		5.		6.	

4. **I feel comfortable when I don't understand the reason why an event occurred in my life**

1.		2.		3.		4.		5.		6.	

5. **I feel irritated when one person disagrees with what else in a group believes**

1.		2.		3.		4.		5.		6.	

6. **I don't like going into a situation without knowing what to expect from it**

1.		2.		3.		4.		5.		6.	

7. **When I have made a decision, I feel relieved**

1.		2.		3.		4.		5.		6.	

8. **When I am confronted with a problem, I am dying to reach a solution very quickly**

1.		2.		3.		4.		5.		6.	

9. **I would quickly become impatient and irritated if I could not find a solution to a problem immediately.**

1.		2.		3.		4.		5.		6.	

10. **I do not like to be with people who are capable of unexpected actions**

1.		2.		3.		4.		5.		6.	

11. **I dislike it when a person's statement could mean different things.**

1.		2.		3.		4.		5.		6.	

12. **I find establishing a consistent routine enables me to enjoy life more**

1.		2.		3.		4.		5.		6.	

13. **I enjoy having a clear and structured mode of life**

1.		2.		3.		4.		5.		6.	

14. **I do not usually consult many different opinions before forming my own view**

1.		2.		3.		4.		5.		6.	

15. **I dislike unpredictable situations**

1.		2.		3.		4.		5.		6.	

Appendix E

The Effects of Snap Decision Making on Episodic Recognition Memory

Participant Consent Form

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.
4. I understand that the study involves making a two-stage decision in a recognition memory task for words. I have read and understood the experiment instructions provided on the information sheet.
5. I understand that participation involves no foreseeable risks. I may experience some fatigue. I understand that it is recommended that I take short breaks when prompted to.
6. I understand that all research data will be securely stored on the University of Tasmania premises for a minimum of five years from the publication of the study results, and will then be destroyed.
7. I understand that my de-identified electronic data will be made available to other researchers on an Open Science Framework site indefinitely.
8. Any questions that I have asked have been answered to my satisfaction.
9. I understand that the researcher(s) will maintain confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research.
10. I understand that the results of the study will be published so that I cannot be identified as a participant.
11. I understand that my participation is voluntary and that I may withdraw without explanation up until I complete the experiment.

    I understand that I will not be able to withdraw my data after completing the experiment as it will be non-identifiable.

Participant's name: _____

Participant's signature: _____

Date: _____

Statement by Investigator

☐ I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

☐ The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator's name: _____

Investigator's signature: _____

Date: _____

Appendix F

Participant Information Sheet

The Effects of Snap Decision Making on Episodic Recognition Memory

Participant Information Sheet

1. Invitation

You have been invited to participate in the research being conducted in partial fulfilment of a Bachelor of Psychological Science with Honours degree for Bryana Frazer under the supervision of Prof Andrew Heathcote.

2. What is the purpose of this study?

The aim of the study is to determine the influence of personality for making a snap decision and change of mind, in a recognition memory task.

3. Why have I been invited to participate?

You have been invited to participate as you met the requirements for participation (i.e., you are 18 years or older). If you are a first year psychology undergraduate student you have replied to the SONA advertisement. If you are not a first year psychology student then you have seen an advertisement for the study and contacted Bryana with an expression of interest. The choice to participant is entirely voluntarily. There will be no consequences should you decide not to participate.

4. What will I be asked to do?

You will be asked to make a two-stage decision. First, you will be asked to study a list of words. You will then see another list of words, and for each word you will be asked to rapidly decide whether you have seen this word before (i.e., did you study it?) or not. Following this decision, you will then be asked to rate your confidence on your decision (old high, old low, new high, new low). This process will repeat for every word in each cycle of word lists you see. The entire experiment will be conducted here in the cognition lab, in 2 one hour sessions. You will be given these instructions in more detail along with practice trials prior to starting the experimental trials.

5. Are there any possible benefits from participation in this study?

There are no direct benefits to participants. The data collected in this research will provide further understanding on the effects of snap decision making on episodic recognition memory.

Directly following the completion of the experiment, first year psychology students will receive one hour of course credit via SONA for participating in the study, other participants will receive $15/hr from the experimenter as remuneration for your time.

6. Are there any possible risks from participation in this study?

There are no foreseeable risks involved with participating in this study. You may experience some fatigue. It is therefore recommended that you take a short break when prompted to.

7. What if I change my mind during or after the study?

If you wish to withdraw from the experiment you may do so without explanation up until you complete the experiment. It will not be possible to withdraw your data once you have completed the experiment as all collected data is de-identified. This means that your name is

not attached to any data that is collected, and thus cannot be identified. If you do not want your data to be collected, please withdraw before completing the experiment.
All de-identified data will also be made available to other researchers on an Open Science Framework (OSF) site. By signing the consent form you are consenting to your data being collected for the current study AND being made available on the OSF site. If you do not want your data made available to other researchers on the OSF site, please do not participate in the study, or if you change your mind once you have started, please withdraw before completing the experiment.
If you decide to withdraw part way through the experiment your incomplete data file will be deleted immediately.

8. What will happen to the information when this study is over?

Your consent form will be stored in a locked filing cabinet in the Cognition Lab. Electronic data files will be stored on a password protected server in the Cognition Lab. Hard copy and electronic files in the Cognition Lab will be kept for a minimum of five year before being destroyed. However, de-identified electronic data will be made available indefinitely to other researchers on an OSF site.

9. How will the results of the study be published?

The results of this study will be published as part of an honours thesis. Once published, the thesis will be accessible through the University of Tasmania library catalogue search function and the results of the study will be viewable. Alternatively, you may request a summary of the results by contacting Bryana (bryana.frazer@utas.edu.au). Results will be available in November. Participants will not be identifiable in the published results.

10. What if I have questions about this study?

If you have any questions or concerns about the study please contact either Ellen-Jane (bryana.frazer@utas.edu.au) or Andrew (Andrew.heathcote@utas.edu.au).
This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number **H0016517**.
This information sheet is for you to keep. You will be given a separate consent form to read and sign should you choose to participate in the study.